SOIL, TREES CAN'T GROW WITHOUT IT

Soil t-shirt.
Duane McCoy, DNR Forestry

There is a T-shirt that has a picture of some trees and their root systems in a soil profile. The caption says "soil, we can't grow without it."

The first time I saw these shirts, I liked them because their slogan took the complex interactions I was spending years of my life studying and boiled them down to one basic truth: Without good soils, our trees cannot grow and flourish the way we want them to, regardless of whether we focus on fiber production or conservation of the forest ecosystem as a whole. The more "things" impacting our soils, the more limited the soil will be in providing nutrients, water, air and all the other things that are needed to help trees grow.

In Indiana we need to remember that past practices and modern problems have affected and will continue to affect our soils. Areas in southern Indiana are missing the topsoil they had before the period of subsistence farming that continued until the Depression. Those soils have had only 80 to 100 years of recovery. That is a short time compared to the hundreds of years it takes to develop good topsoil structure. North American forests, as a whole, are also impacted by European earthworms that have thinned the organic matter (OM) in and on the forest floor, as well as changed the soil structure. Trails already exist in areas that may be good to use or disastrous, depending on their past use (county road, skid trail or farm equipment path), level and frequency of use, when they were used (100 years ago versus five years ago), and placement on the landscape (top or bottom of the hill or on the slope). The wildcard of long term weather patterns affects the winter frost line in a soil. These weather patterns also affects how much precipitation a soil receives and in what form, when plants and critters might be active or dormant, and probably many other things we do not know yet, and it is always changing.

Our Indiana soils need care in order to maintain their current condition, or to return to a more stable and "natural" condition if other land uses (cropping, grazing, development, etc.) have been done upon them. In Indiana forestry, we refer to this care of forest soils as best management practices (BMPs). However, our BMPs are focused on how to minimize our impacts to soils and protect water quality while we harvest timber. In Indiana forestry, most of the work that might impact soils occurs during the harvests. We run equipment through the woods cutting the trees to be harvested, move them from stump to landing, cut the stems into logs, stack them, then load them onto the truck to be taken to the concentration yard or mill. We use few chemicals or fertilizers in Indiana forestry because our soils have most of the nutrients forested ecosystems need.

Skidder using a log bridge to cross a drainage.
DNR Forestry

If we assume that BMPs appropriately minimize our impacts to soil while harvesting timber, there are also other things we do in the woods that might affect the health of the soil. We like to ride horses, drive all terrain vehicles (ATVs), and do other activities that can impact soil health, except these occur more frequently than harvests and keep the soil from recovering. Harvest frequency in a forest is about every 15 to 30 years. That gives the soil time to recover from most of the impacts, depending on their severity and the soil. An ATV or horse trail that is used regularly does not allow the soil time to recover between uses. Examples are a skid trail in a forest just a few years after its use, and a regularly used ATV trail. Within a year of a harvest, leaf fall begins to cover the skid trail, and some vegetation may start to grow, depending on the amount of use the trail received and the soil structure. On an ATV

trail that is used even monthly, the OM is kept off the soil. The top of the soil is hard (compacted), and is likely to stay that way until the trail is allowed to recover for a long time.

Places where the soil is not given adequate time to recover affect the root systems of the adjacent vegetation by degrading the porosity, OM, and other important aspects of the soil and soil organisms. The amount of area with trails affects the health of more of the forest ecosystem as well as the profit you might derive from it.

To keep soils productive, we need to operate so that water can move into, within and through the soil profile. This occurs by having a good distribution of large-to-small air spaces throughout the soil profile. This is called porosity. With good porosity, water can move into the soil by air having an equal amount of space to get out of the way of the water. This allows water to get into the profile, fill the smaller spaces, adhere to some of the soil particles around the larger spaces, and get through the profile to the next space. If there is not enough open space in the soil, pressure can slow or stop water movement through the profile, causing it to pool in and on top of the soil. This forces the water to look for the next place that gravity wants it to go, which is down the hill on top of the soil profile (overland flow), sometimes taking some of the soil particles with it (erosion). Another impact of making these larger pores smaller is that the soil holds more water stringently. This keeps air out, causes a reduction in respiration of the roots, and keeps the roots from taking in water by the soil holding it tighter. Porosity is a component of soil quality that has a big impact on soil and forest health.

Organic material (OM) is important to soil health, too. OM is all the leaves, twigs and other forest detritus produced by the flora and fauna within and above the soil. OM is deposited on and in the forest floor, armoring and protecting the soil from two of the most destructive forces on the planet, wind and rain. The OM then serves as food for organisms that decompose into the soil's elemental parts and interact with the mineral components of the soil physically and chemically. The organisms are sometimes above the soil and sometimes within the soil profile, breaking down those parts to smaller parts, and while doing so, cementing some soil parts together, causing what are commonly called clods. All of this armoring, decomposing, and interacting positively affects the porosity of the soil and helps to maintain the structure of the soil so that it can hold up trees, and provide a balance of the water, air, nutrients and chemicals that the soil and organisms need to thrive.

Forestry team reviewing best management practices on a timber sale.
DNR Forestry

We need to recognize the impacts we have on the soil that we depend on for recreation, spiritual revitalization, income and economic stabilization. Once we recognize the need to keep the forest ecosystem intact for ourselves and our children and grandchildren, then we will see the need to practice this conservation. We can do so by minimizing the amount of land we use for high-impact trails and by placing these trails in a way that minimizes our impacts on the soil structure. Design trails so water can move off them and be deposited onto the forest floor in small amounts. This will allow the adjacent forest floor to absorb that water and move it through the soil profile. Do not let the water go directly into a stream or lake. Stabilize and maintain trails so they have as little area as possible, minimize compaction and erosion, and maintain soil and water quality throughout the site.

Many organizations and resources can help. Using these and the myriad of other available online sources can help you have fun in your forest while helping it thrive and remain stable for the future:

DNR Division of Forestry website: http://www.in.gov/dnr/forestry/
Purdue Forest & Natural Resources: https://ag.purdue.edu/fnr/Pages/default.aspx
Purdue Extensions' The Education Store:https://mdc.itap.purdue.edu/
Indiana Forest and Woodland Owner's Association (IFWOA): http://www.ifwoa.org
U.S. Forest Service: http://www.fs.fed.us/research/products/ .